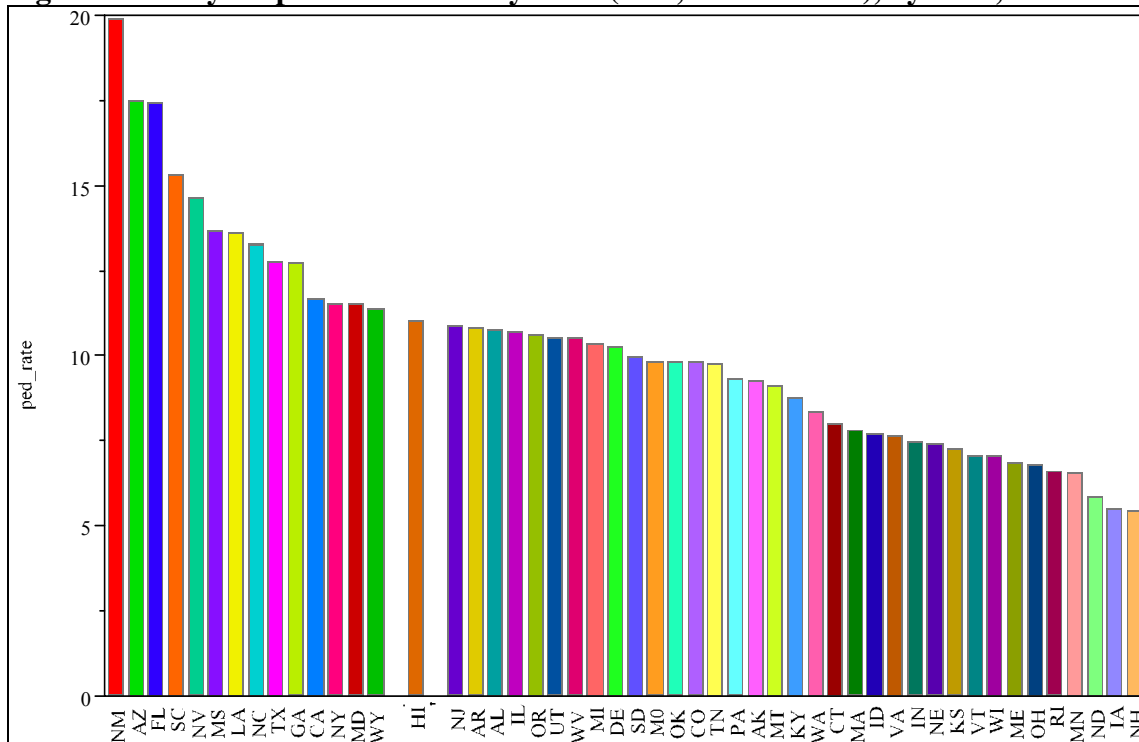




Profile: Pedestrian Injuries

Pedestrian injuries were the fifth leading cause of fatal unintentional injuries among Hawai'i residents from 1996 to 2003, where 233 pedestrians were killed over the 8-year period. The rate in Hawai'i was the 15th highest in the country from 1997 to 2001, averaging 2.2 deaths per 100,000 residents per year (see Figure 1). (These rate comparisons include only resident deaths for each state. In general, the statistics in this report describe injuries to both residents and non-residents, unless otherwise noted.)

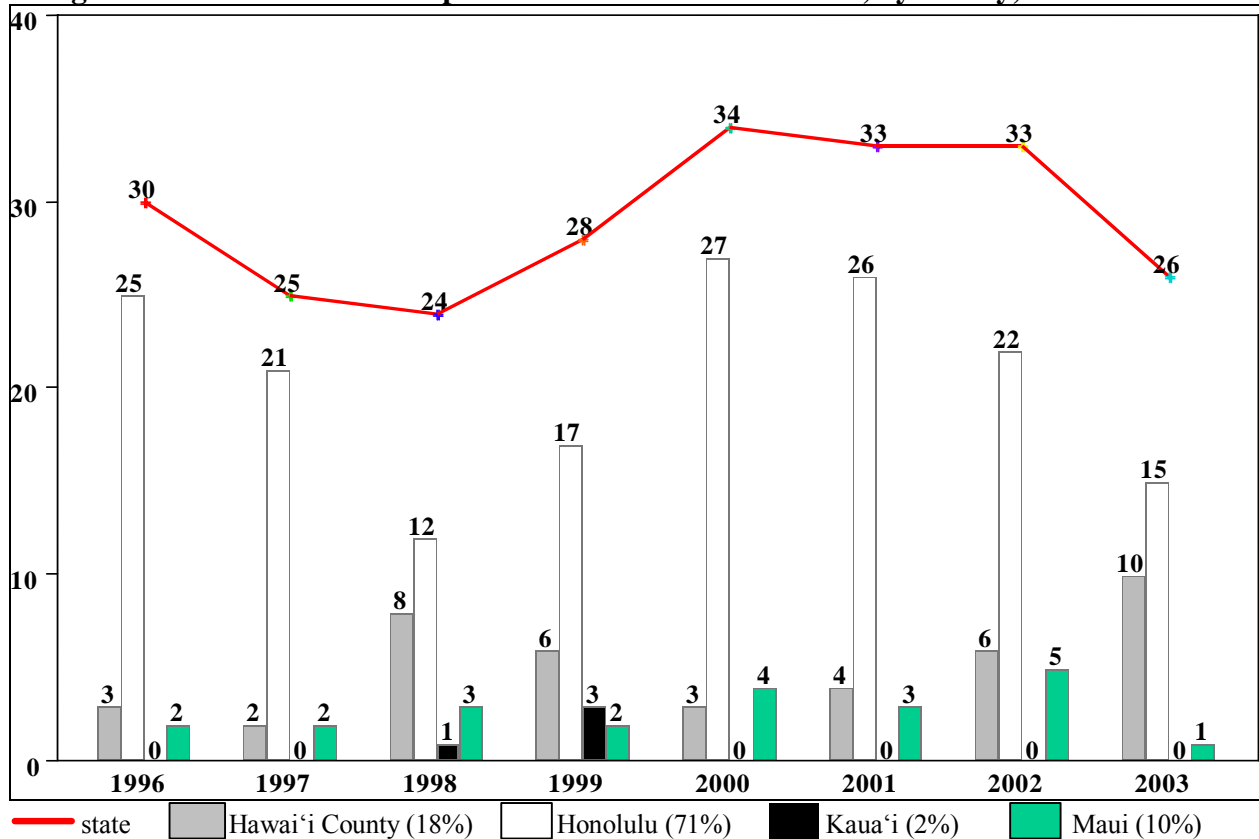
Figure 1. Five-year pedestrian fatality rates (/100,000 residents), by state, 1997-2001.



The annual number of deaths fluctuated between 24 and 34 (see Figure 2). Almost three-fourths of the victims (165, or 71%) were struck on O'ahu. Another 42 victims were struck on the island of Hawai'i, 22 on the island of Maui, and 4 on Kaua'i. The annual total on O'ahu resembled that for the state. The highest total for Hawai'i County occurred in 2003, while there have been no fatalities in Kaua'i County since 1999. Most (219, or 94%) of the victims were residents of Hawai'i. Among the fatally injured residents, Hawai'i County had the highest 8-

year rate of pedestrian fatalities (27.2/100,000 residents). This rate was significantly higher than those computed for Honolulu (17.7/100,000) or Maui counties (15.1/100,000). (A reliable rate estimate could not be computed for Kaua'i County, since the number of deaths there (i.e., four) was low.)

Figure 2. Annual number of pedestrian fatalities in Hawai'i, by county, 1996-2003.



The ages of the victims ranged from infancy to 94 years, but about half (113, or 48%) were 65 years or older (see Figure 3). Ten victims were between the ages of infancy and four years. The proportion of senior-aged victims was much higher on O'ahu (59%) than on the Neighbor Islands (26%). Almost all (90%) of the victims aged 85 years or older were struck on O'ahu. The majority of victims (145, or 62%) were males, although gender was more evenly distributed across the youngest age groups. The proportion of female victims was greater among those struck on O'ahu than on the Neighbor Islands (43% vs. 27%).

Figure 3. Age and gender distribution of fatally injured pedestrians in Hawai‘i, 1996-2003.

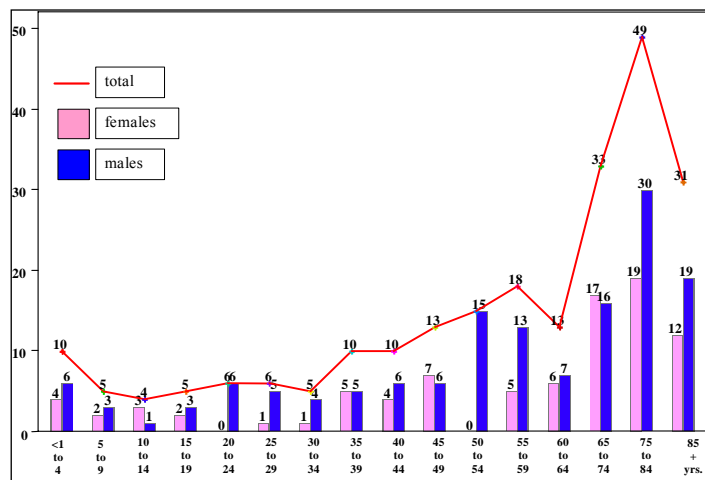


Figure 4 shows that the high number of senior-aged victims translated into very high rates of fatal pedestrian injuries, after adjusting for resident population. (These calculations include only victims who were residents of Hawai‘i.) Fatality rates also increased dramatically across the senior age ranges, as rates among residents aged 85 years and older were twice as high as those among 75-84 year-olds, and four times as high as those for 65-74 year-olds. Rates at other ages are relatively low, although

they began increasing slightly around age 45. Figure 4 also shows that rates were higher among male residents at almost every age, particularly among those 75 years of age and older.

Figure 4. Pedestrian fatality rates (/100,000) among residents of Hawai‘i, by age and gender, 1996-2002.

There was no clear pattern to the month in which these fatal crashes occurred. Tuesday was by far the most common day on which these injuries occurred (50 deaths). Friday (37 deaths) and Saturday (35) were also common, while the fewest number (24) occurred on Sundays. The crashes occurred at all hours of the day, but there were two noticeable peak periods: 68 (29%) crashes occurred between 5:30 a.m. and 8:30 a.m., and 46 (20%) took place between 5:30 p.m. and 8:30 p.m. (see

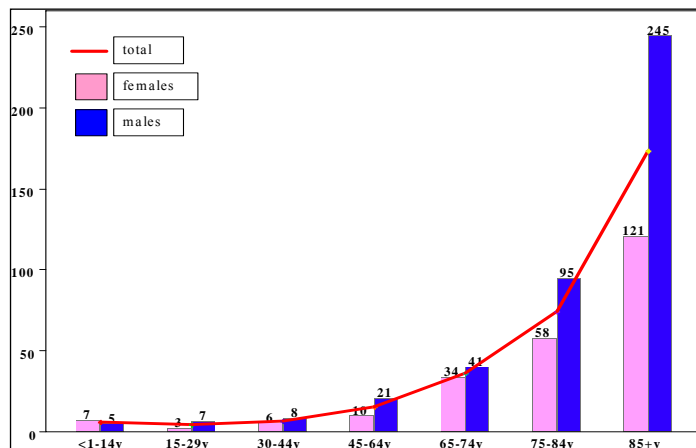
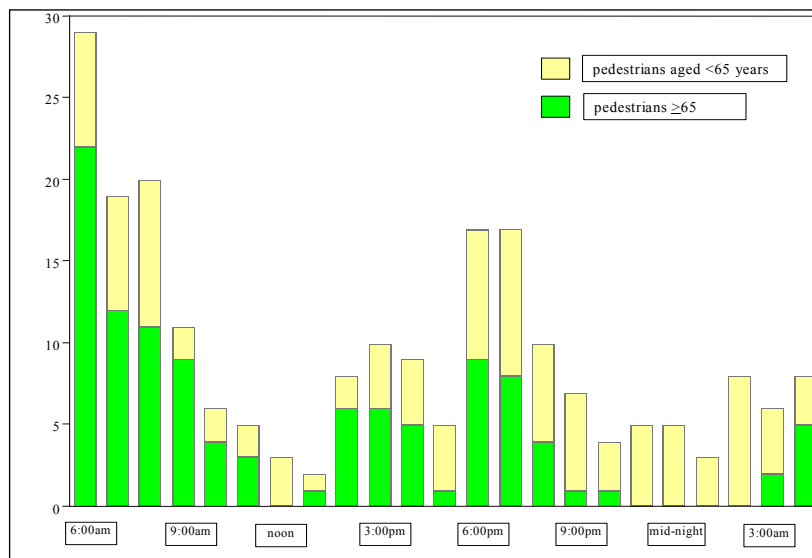


Figure 5). Pedestrians on the Neighbor Islands were more likely to be killed in nighttime crashes (i.e., between 6:30 p.m. and 5:30 a.m.) than pedestrians on O‘ahu (45% vs. 32%, respectively). Figure 5 also shows an association between the age of the victim and the time of the crash. More than two-thirds (67%) of those hit between 5:30 a.m. and 10:30 a.m. were 65 years or older. Only one-fifth (19%) of the senior-aged victims were hit during nighttime hours (6:30 p.m. to 5:30 a.m.). Most (72%) of the pedestrians who were hit during nighttime hours (6:30 p.m. to 5:30 a.m.) were under age 65; only 28% were seniors.

Figure 5. Fatal pedestrian injuries among residents in Hawai‘i, by time of day and age of victim, 1996-2003.



Detailed crash data from the Fatal Analysis Reporting System (FARS) of the NHTSA was available only for crashes through 2002 at the time this report was compiled. About 86% of the 1996 to 2002 fatalities could be matched to FARS records, as the FARS system only covers crashes that occur on public roads.

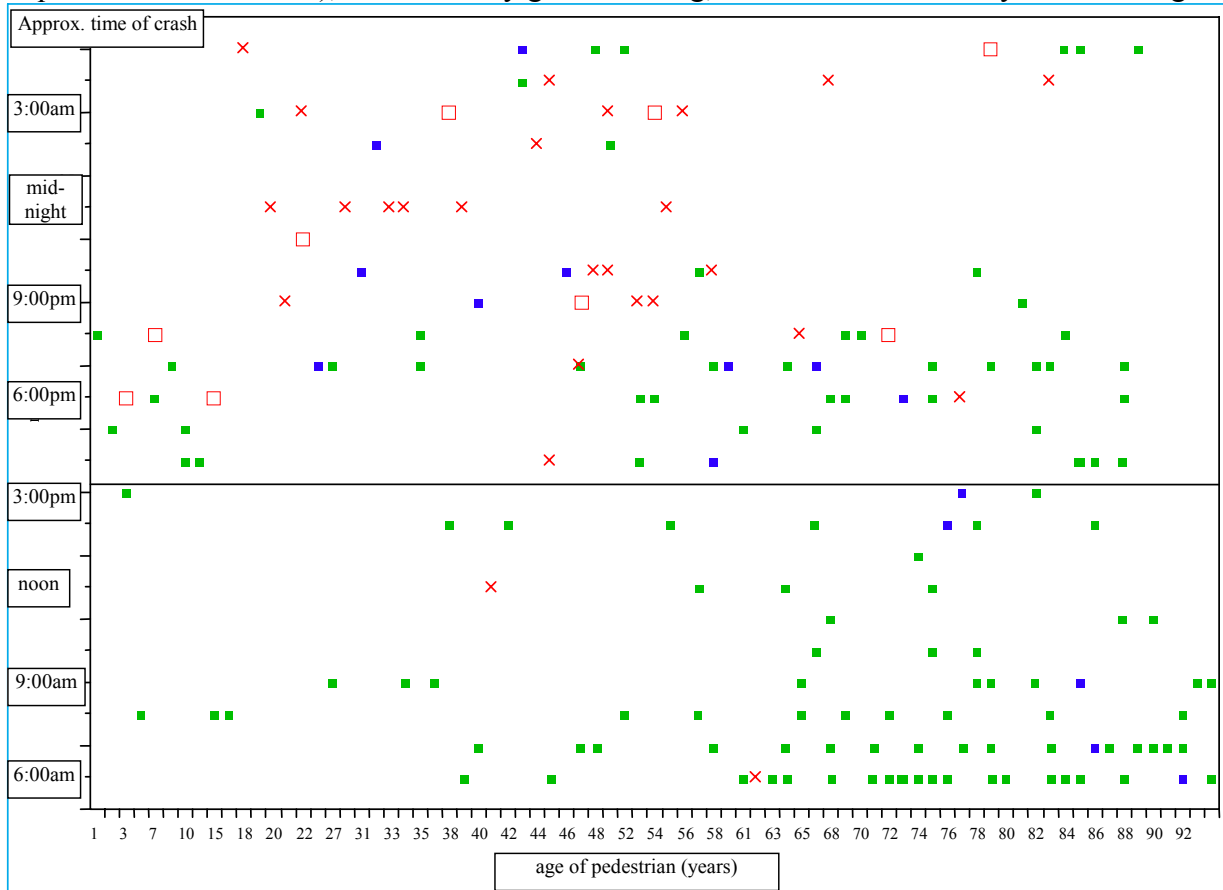
According to FARS data, alcohol was involved in about one-fifth (21%) of the deaths. (This includes crashes

for which alcohol status was unknown. Alcohol was involved in 25% of the deaths if the unknown cases are not included.) Fifteen percent of the pedestrians had been drinking prior to the crash, and 10% were estimated to have been over the legal limit. Another 6% of the pedestrians were hit by a driver who had been drinking.

Alcohol use by pedestrians varied by age and gender, as well as by the time and location of the crash. (The following statistics include only pedestrians 15 years and older.) Alcohol use among pedestrians hit during the nighttime (6:30 p.m. to 5:30 a.m.) was much more common (35%), compared to those hit during daylight hours (4%). Alcohol use was also much more common among victims hit on the Big Island, as 35% were estimated to have been drinking prior to the crash. In comparison, only 13% of the victims hit on O‘ahu and 6% of those struck on Maui had used alcohol. Alcohol use was significantly more common among the male victims (22%) than the female victims (6%). Victims who had been drinking were significantly younger than non-drinkers (average age: 47 vs. 68 years). Nearly one third (31%) of the victims aged 20-59 years had been drinking, compared to only 4% of the senior-aged victims. There were no clear trends in alcohol use by victims over the 8-year period. Figure 6 graphically summarizes some of the relationships between victim age, time of crash and alcohol involvement. Most of the red shading (indicating alcohol involvement) is clustered in the 8:00 p.m. to 4:00 a.m. period, among victims aged 20 to 60 years. There is another cluster of green-shaded (no alcohol) senior-aged victims who were struck in the morning or mid-day hours.

Figure 6. Temporal characteristics of fatal pedestrian crashes in Hawai'i, 1996-2002, by alcohol status of victims aged 15 years or older.

Alcohol involvement indicated by red shading ("x" indicates pedestrian who had been drinking, squares indicate drivers), no alcohol by green shading, and unknown status by blue shading.



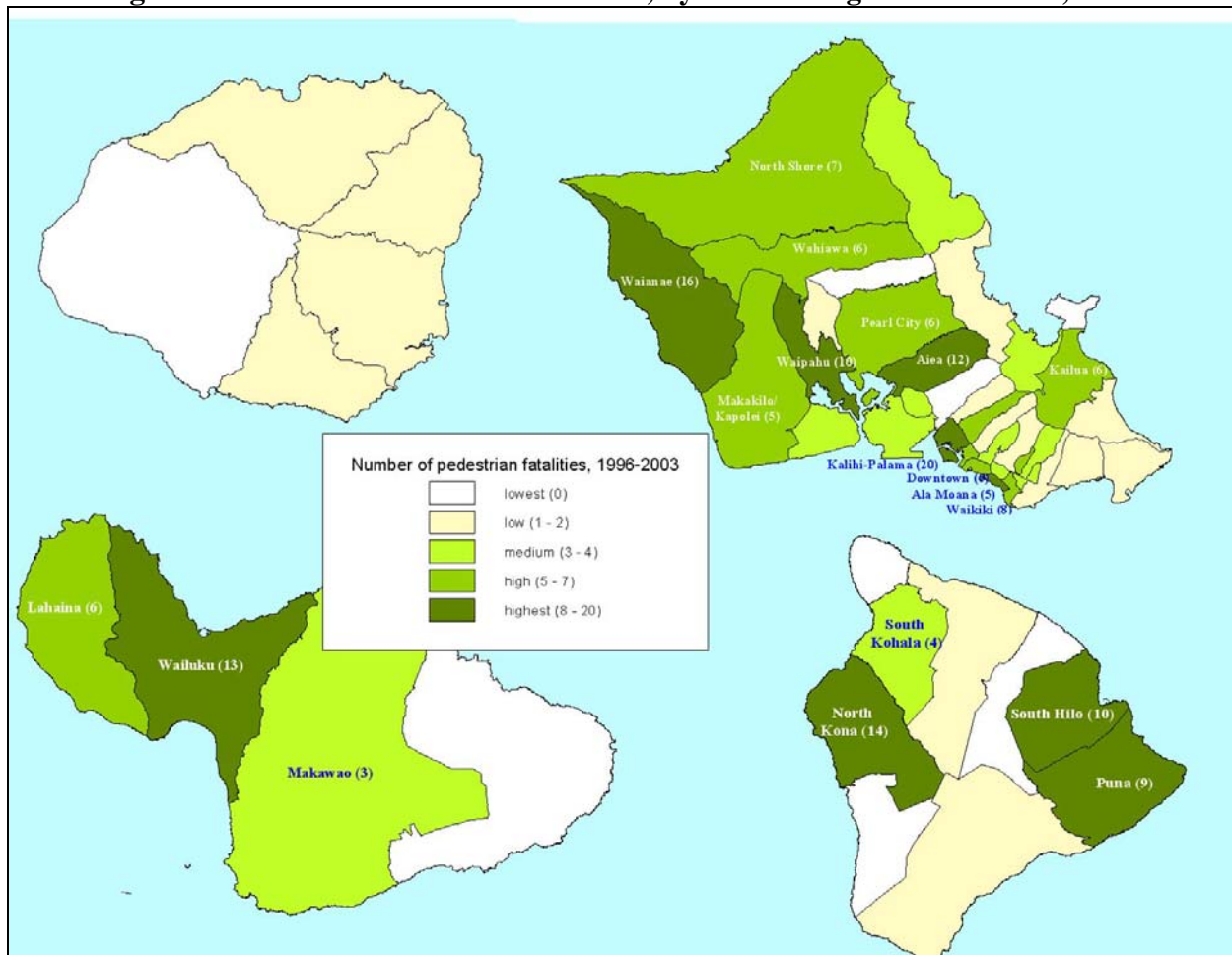
According to FARS data, errors or “contributing factors” (including alcohol consumption) were made in roughly equal proportions by both pedestrians and drivers involved in the crashes. More than half (54%) of the pedestrian victims were in the roadway erroneously, most commonly by “improper crossing of roadway or intersection” (i.e. jaywalking) (54, or 33% of the victims). Twenty-three pedestrians were otherwise walking, sitting or standing in the roadway, and 22 had darted onto the road. Seven of the victims were reportedly “not visible” to the drivers. About half of the drivers involved in the crash (61, or 54%) made an error which contributed to the crash. Most commonly, there was a “failure to yield right of way” on the part of 53 (31%) drivers. Thirty-nine were described as “inattentive”, 16 were speeding, and 10 failed to stay in the proper lane. Overall, no errors were documented on the part of either the pedestrian or the driver in only 11 (6%) of the fatalities.

Following is a series of maps showing the sites of crashes which resulted in pedestrian fatalities. Also indicated on some maps are the “errors” or “contributing factors”, whether on the part of the pedestrian, the driver, or both. For the pedestrian, “error” means the use of alcohol or pedestrian presence in the roadway as the result of jaywalking, ignoring traffic signs

and signals, or other incorrect behaviors. For drivers, “error” also means the use of alcohol, or speeding, inattention, or other poor driving actions.

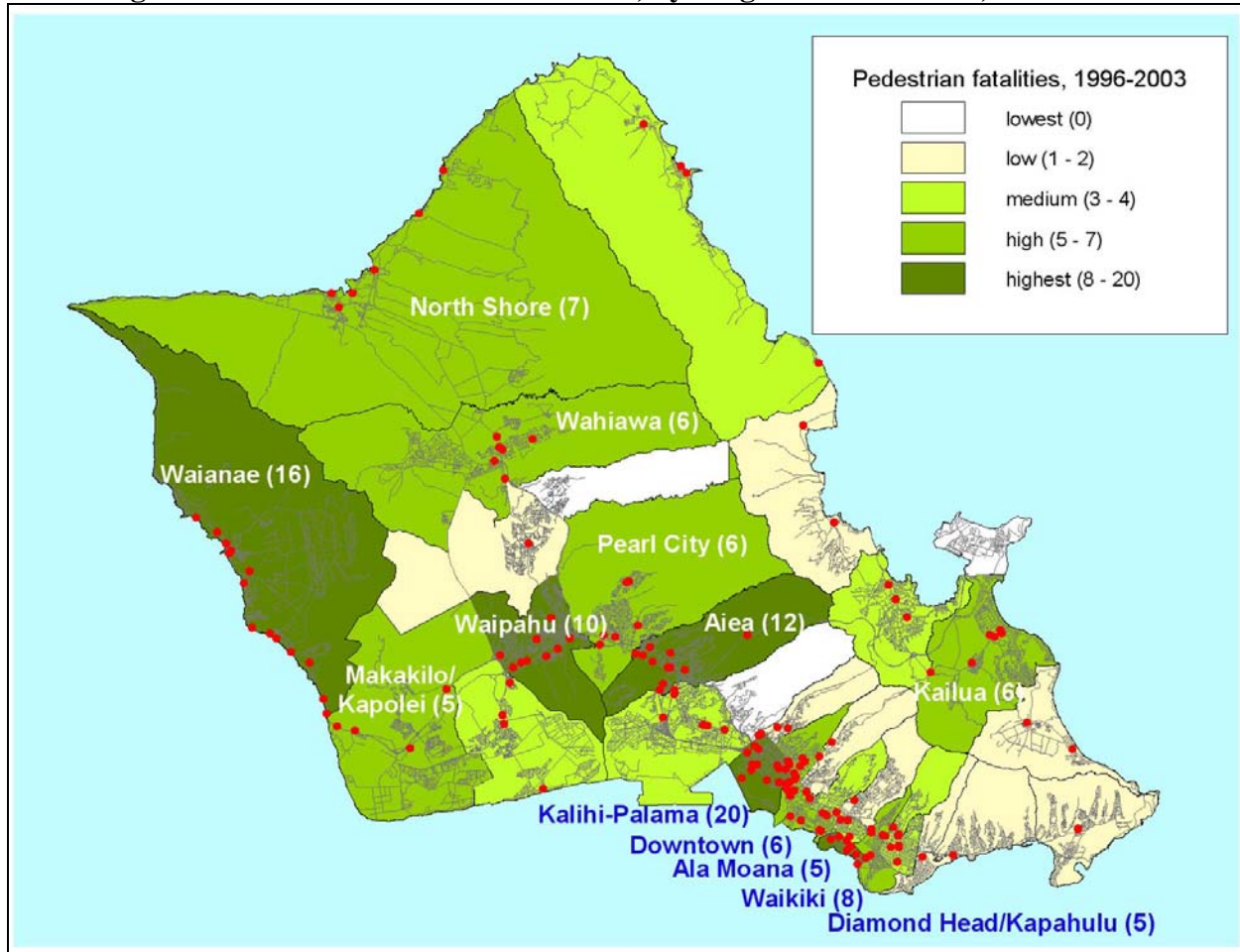
Figure 7 shows the total number of pedestrian fatalities within geographic areas in the state (districts for Neighbor Islands, Neighborhood Boards for O‘ahu). Areas with the darker shading had the “highest” fatality totals (i.e., Kalihi-Pālana, Wai‘anae, ‘Aiea, and Waipahu on O‘ahu; Wailuku district on Maui; and North Kona, South Hilo and Puna districts in Hawai‘i County). Most of the areas with “high” totals were on O‘ahu, except for Lahaina on Maui.

Figure 7. Pedestrian fatalities in Hawai‘i, by district/Neighborhood Board, 1996-2003.



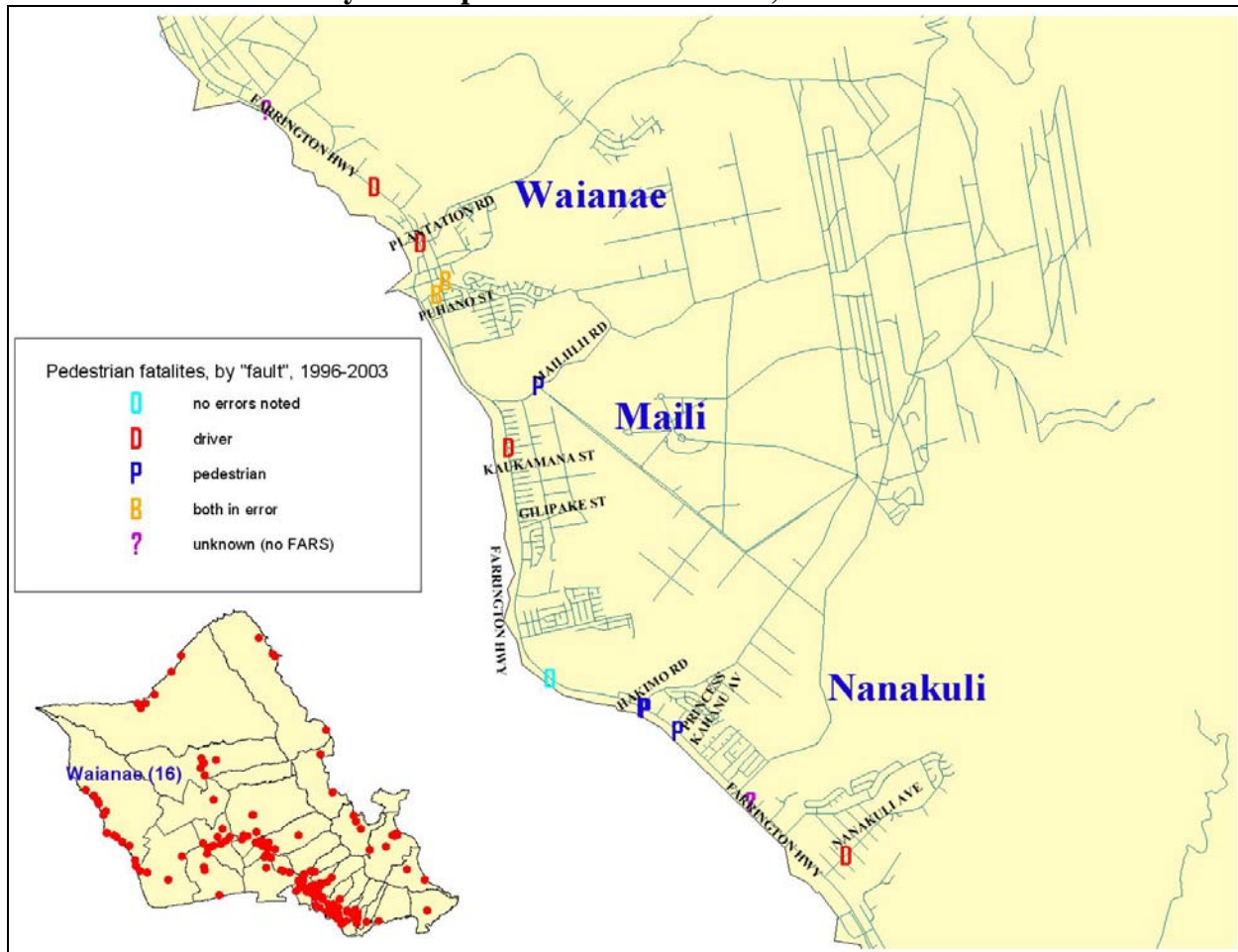
A larger view of the O‘ahu map is given in Figure 8, which also shows the approximate location of individual crashes.

Figure 8. Pedestrian fatalities on O‘ahu, by Neighborhood Board, 1996-2003.



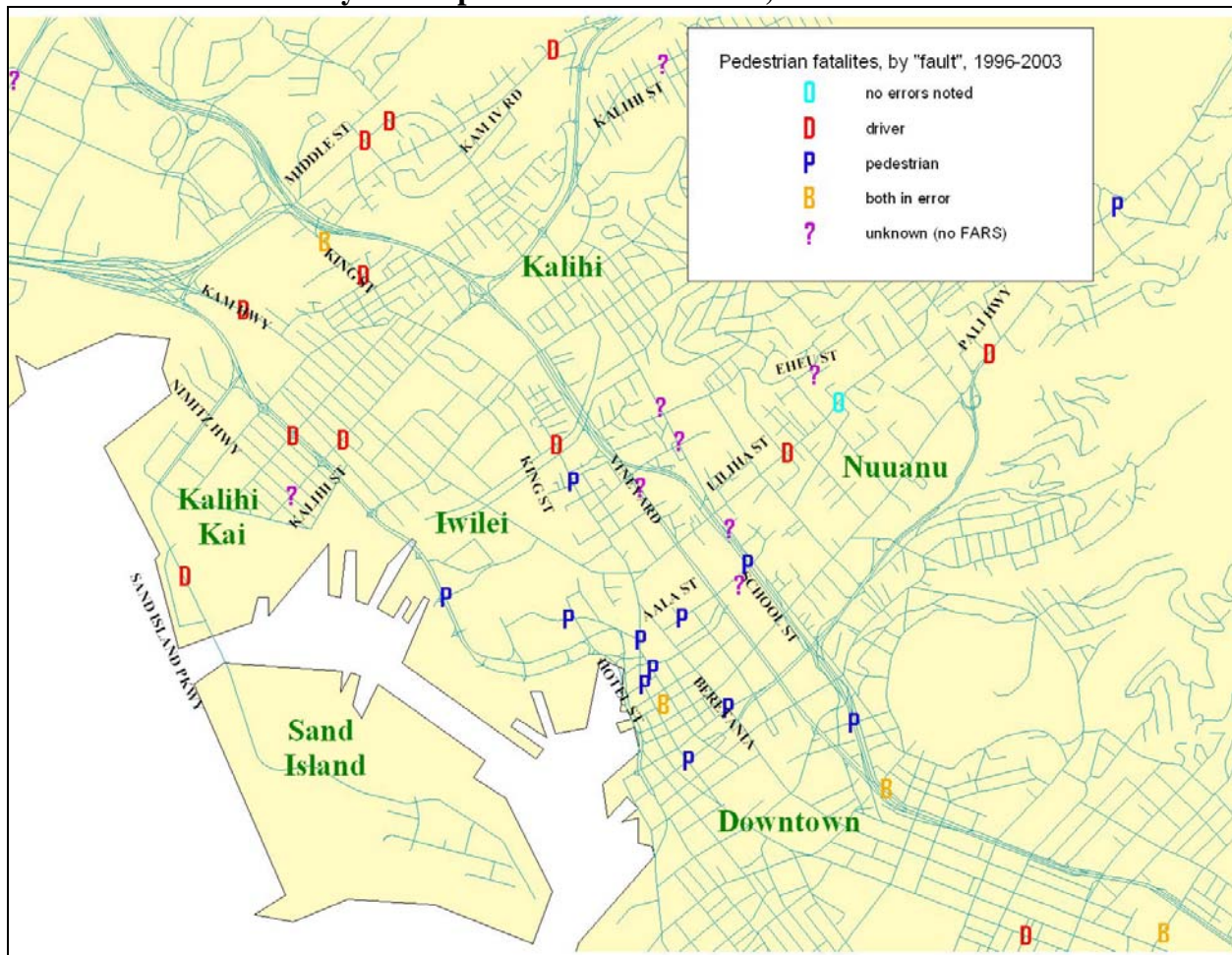
Most of the 16 crashes in Wai‘anae occurred on a long stretch of Farrington Highway, from Nānākuli to Wai‘anae (see Figure 9). The distribution of the icons shows that the fault in the crashes was roughly equally divided between drivers and pedestrians. Most of the crashes (63%) occurred during nighttime hours, in contrast to crashes on other parts of O‘ahu, of which 72% happened during daylight hours.

Figure 9. Locations of pedestrian fatalities in Wai‘anae, by driver/pedestrian error status, 1996-2003.



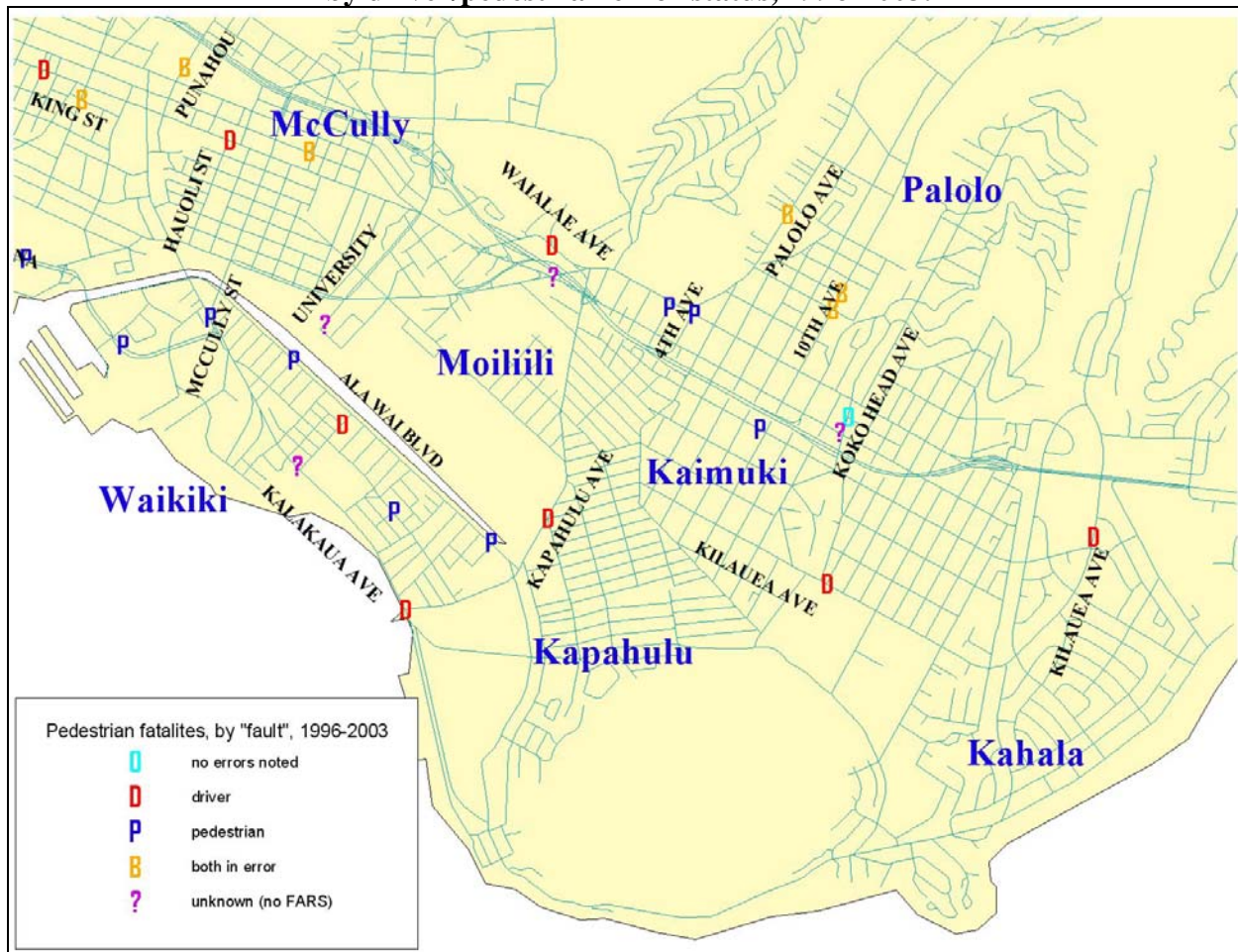
Kalihi-Pālama had the highest number of fatalities, and Figure 10 shows that many of those deaths involved errors on the part of drivers. In contrast, pedestrian errors were documented for almost all of the deaths in the Downtown area. Almost all (88%) of the crashes in the Kalihi-Pālama and Downtown areas happened during daylight hours.

Figure 10. Locations of pedestrian fatalities in eastern Honolulu, by driver/pedestrian error status, 1996-2003.



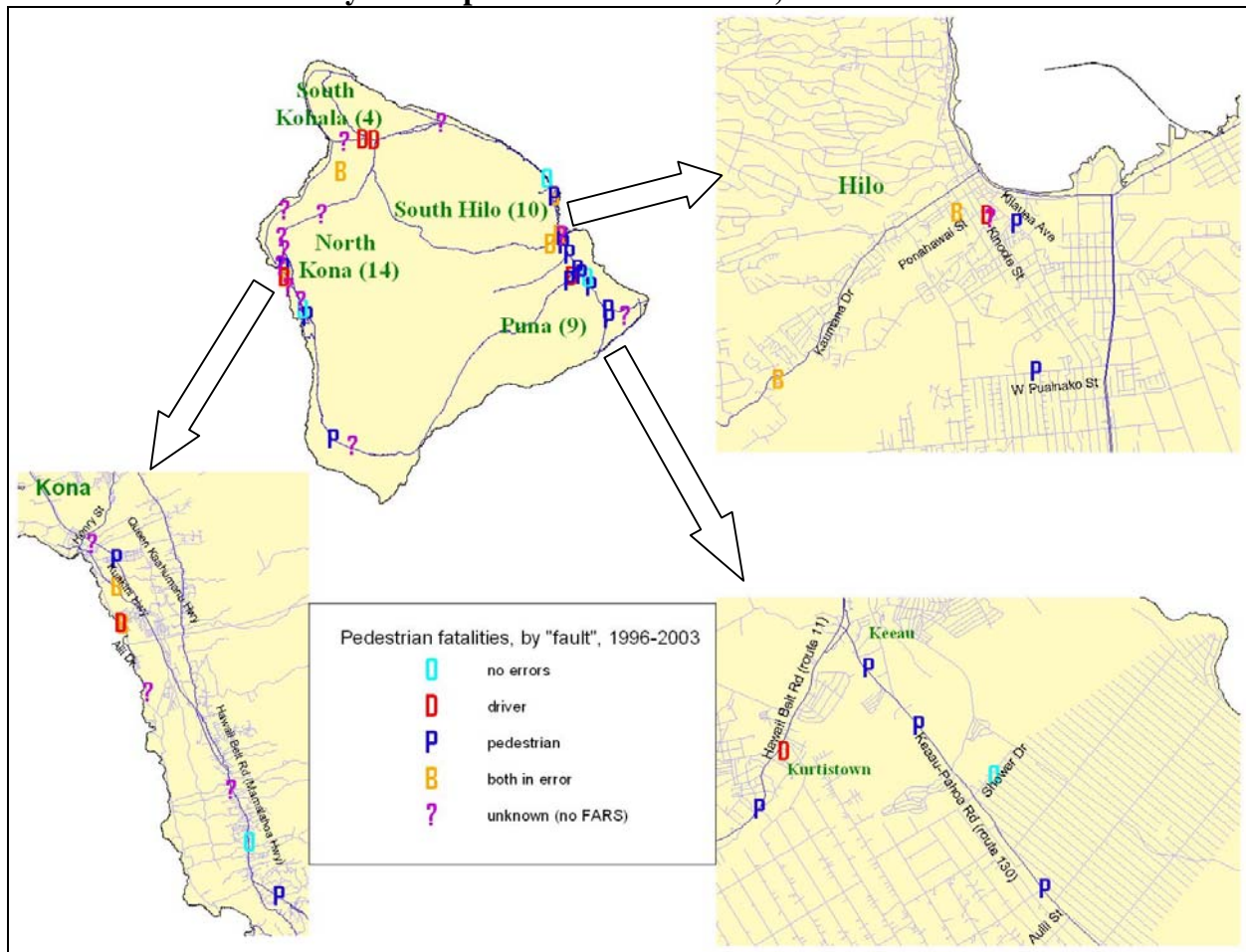
Five of the eight incidents in Waikīkī involved errors on the part of pedestrians, including three who were jaywalking (see Figure 11). Most of remaining crashes in western Honolulu were widely distributed, although there were several areas in Pālolo and Kaimukī where more than one pedestrian was killed.

Figure 11. Locations of pedestrian fatalities in western Honolulu, by driver/pedestrian error status, 1996-2003.



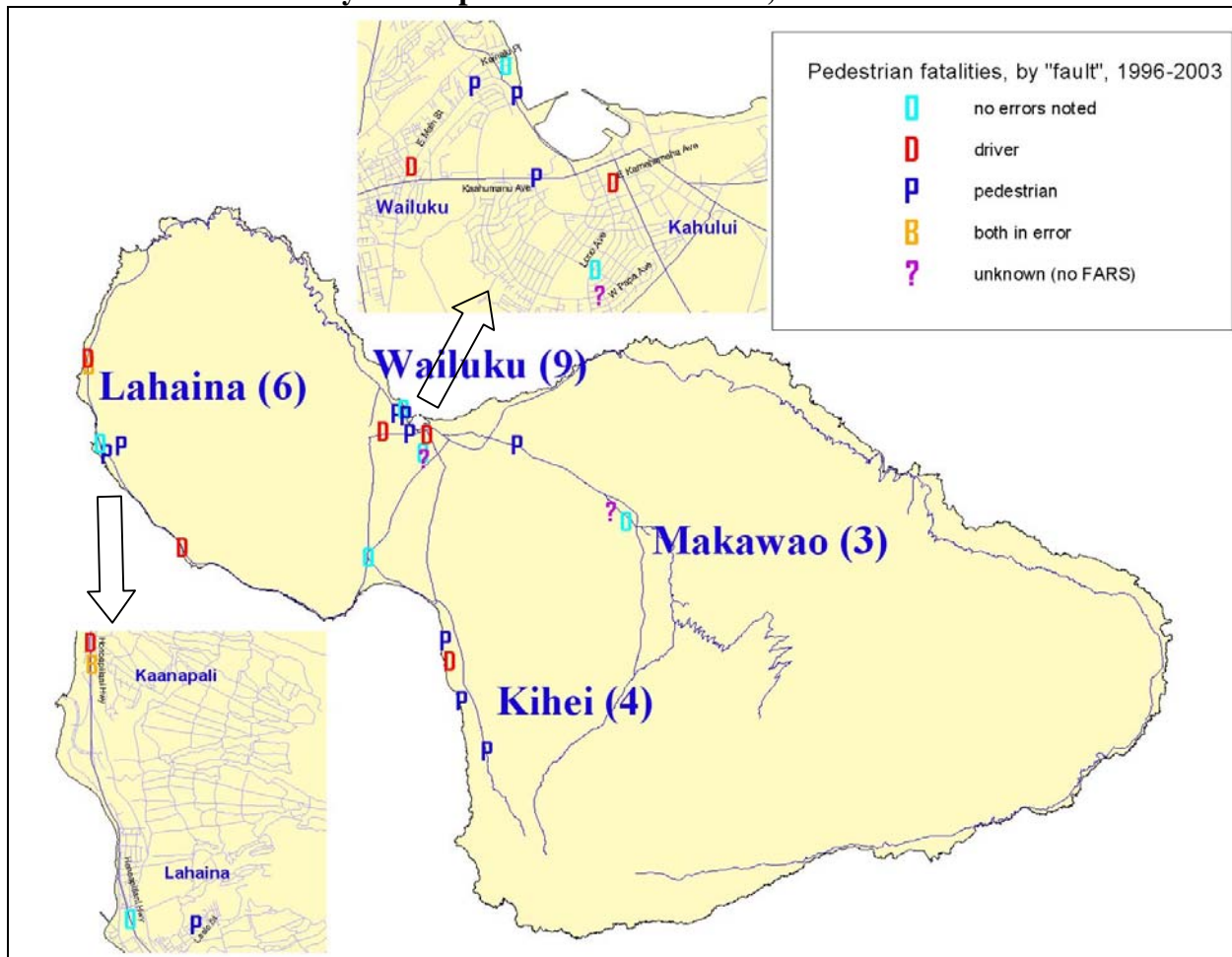
Almost all (88%) of the crashes in the Hilo and Puna areas involved errors on the part of the pedestrian victims, most frequently by being in the roadway (see Figure 12). More than half (56%) of these crashes were during nighttime hours. The crashes in Hilo were widely dispersed around the town. Three pedestrians were hit along the Kea'au-Pāhoa Road (route 130).

Figure 12. Locations of pedestrian fatalities in Hawai'i County, by driver/pedestrian error status, 1996-2003.



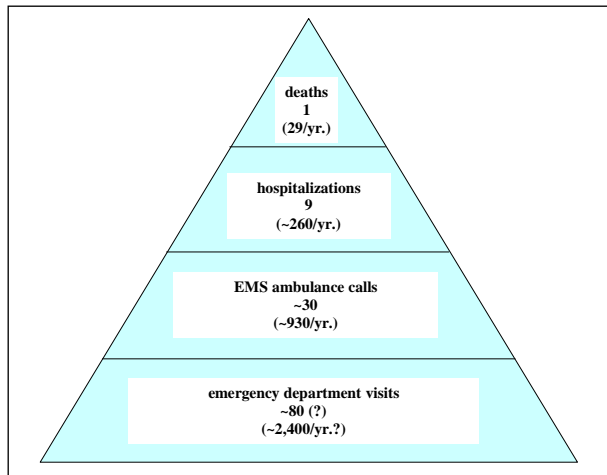
The biggest cluster of pedestrian crashes on Maui was in the urbanized Wailuku/Kahului area, where nine pedestrians were killed (see Figure 13). Another five pedestrians were killed on Honoapiʻilani Highway in western Maui, including two each in the Lahaina and Kāʻanapali areas. Three of the four pedestrians killed in the Kihei area were struck on South Kihei Road.

Figure 13. Locations of pedestrian fatalities in Maui County, by driver/pedestrian error status, 1996-2003.



This report has so far discussed only fatal pedestrian injuries, but fatalities represent only a small proportion of all such injuries that occur. The “Injury Pyramid” in Figure 14 shows that for every pedestrian killed in Hawai‘i, there are an estimated nine who are hospitalized and perhaps as many as 80 who are seen in emergency departments, where more than one third (39%) are transported via ambulance.

Figure 14. The “Injury Pyramid” for pedestrian injuries in Hawai‘i.



The rest of this report will describe mostly non-fatal pedestrian injuries, based on data from two sources: (1) Hawai‘i Health Information Corporation (HHIC), which provides data from hospital discharges, and (2) Emergency Medical Systems (EMS) ambulance reports for Honolulu County. There are limitations to the data from both sources. Identification of pedestrian injuries from hospital discharge data requires external cause of injury coding (“E-codes”), and these were present only for 58% of all injury-related hospitalizations. Also, the extent of E-coding

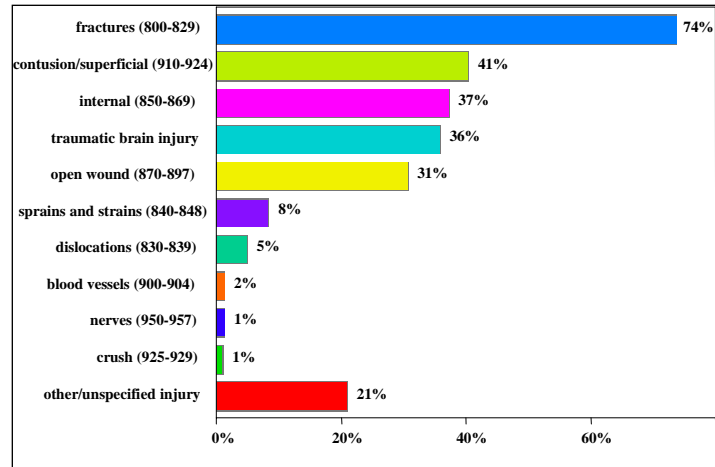
varies by county and within counties over time, so it is not possible to look at county differences in hospitalization or trends over time within a given county. EMS data is available only for Honolulu County for the years 1995 to 1998. Information on pedestrian injuries treated in emergency departments, the “base” of the pyramid, was not available at the time of report compilation.

A total of 897 hospitalizations due to pedestrian injuries were identified over the 6-year period of 1996 to 2001, including 834 patients who ultimately survived. If complete E-coding were assumed, that total is estimated to be about 1,550 -- or 260 per year.

Almost all (89%) of the crashes were coded as traffic crashes, or occurring on public roads; another 10% were not on public roads. One-quarter (24%) of the patients were 65 years of age or older, a much lower proportion compared to fatally injured pedestrians (48%). The highest risk age groups were 5 to 9-year-olds (estimated annual rate: 35/100,000), and those aged 75 and older (39/100,000). The estimated annual rate for all ages is 20/100,000. Rates for all age groups are shown by the yellow bars in Figure 19. Most (60%) of those hospitalized were males, but that proportion varied by age, being highest in patients aged 14 and younger (73% male) and lowest among those 65 years and older (45% male).

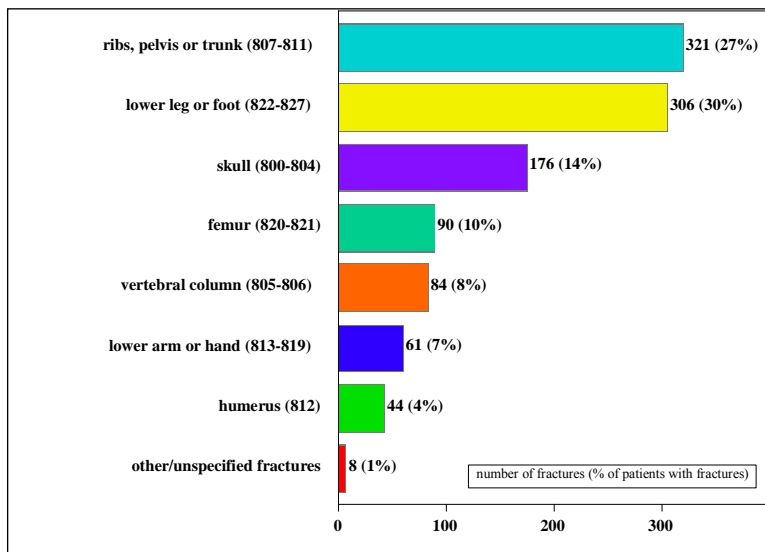
Fractures were the most common type of injury among hospitalized pedestrians, present in three-fourths (74%) of the patients (see Figure 15). Contusions and superficial injuries, internal injuries, traumatic brain injury (TBI), and open wounds were also relatively common, present in about one-third of the patients.

Figure 15. Types of injuries for pedestrians hospitalized in Hawai'i, 1996-2001.
(ICD-9 diagnosis code shown in parentheses.)



Of the 74% of patients who were hospitalized with a fracture, the most common types were fractures of the ribs, pelvis or trunk, or fractures of the lower leg or foot (see Figure 16). These types of fractures were present in almost one-third of the patients. Fourteen percent had a skull fracture, 10% fractured femurs, and 8% fractures of the spinal column.

Figure 16. Types of fractures for pedestrians hospitalized in Hawai'i, 1996-2001.
(ICD-9 diagnosis code shown in parentheses.)



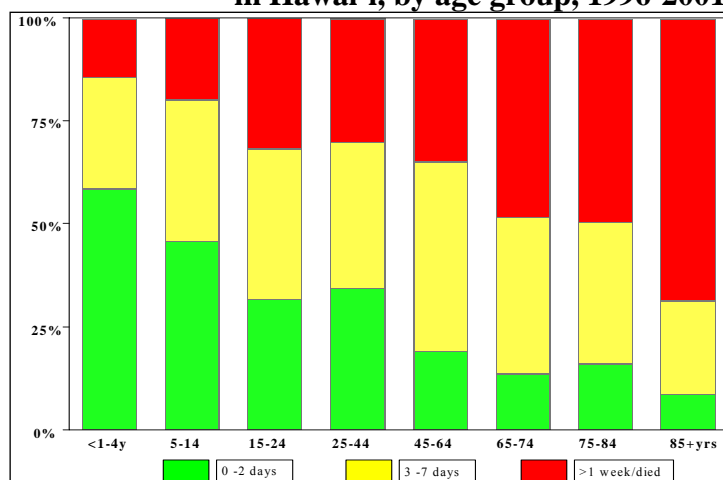
Total hospital charges were estimated at more than \$6.5 million per year, based on an average charge of \$27,000 per hospitalization. (These do not include physician charges, which may double the amount.)

The median length of hospitalization was between 3 and 4 days. About one-third (30%) of the patients were hospitalized for 2 days or fewer, another third (37%) for 3 to 7 days, and the remaining third (33%) were hospitalized for

more than a week or died. Overall, 63 (7%) of the patients died in the hospital. There was a strong association between patient age and the length of hospitalization (see Figure 17). Half (50%) of the patients aged 14 years and younger were hospitalized for 2 days or fewer, and 18% for more than a week or died. The reverse is true for the senior aged patients: half (52%) were hospitalized for more than a week or died, and only 14% had a short stay (2 days or fewer). Figure 17 shows the proportion of patients with a short hospitalization (i.e., up to 2 days) decreased steadily across the age groups, while the proportion with a long or ultimately fatal stay

(i.e., over a week, or died) increased. The proportion of patients with an intermediate length of stay (i.e., 3 to 7 days) varied between 23% and 46%, being highest in the 45 to 64-year age range.

Figure 17. Length of stay for pedestrians hospitalized in Hawai‘i, by age group, 1996-2001.



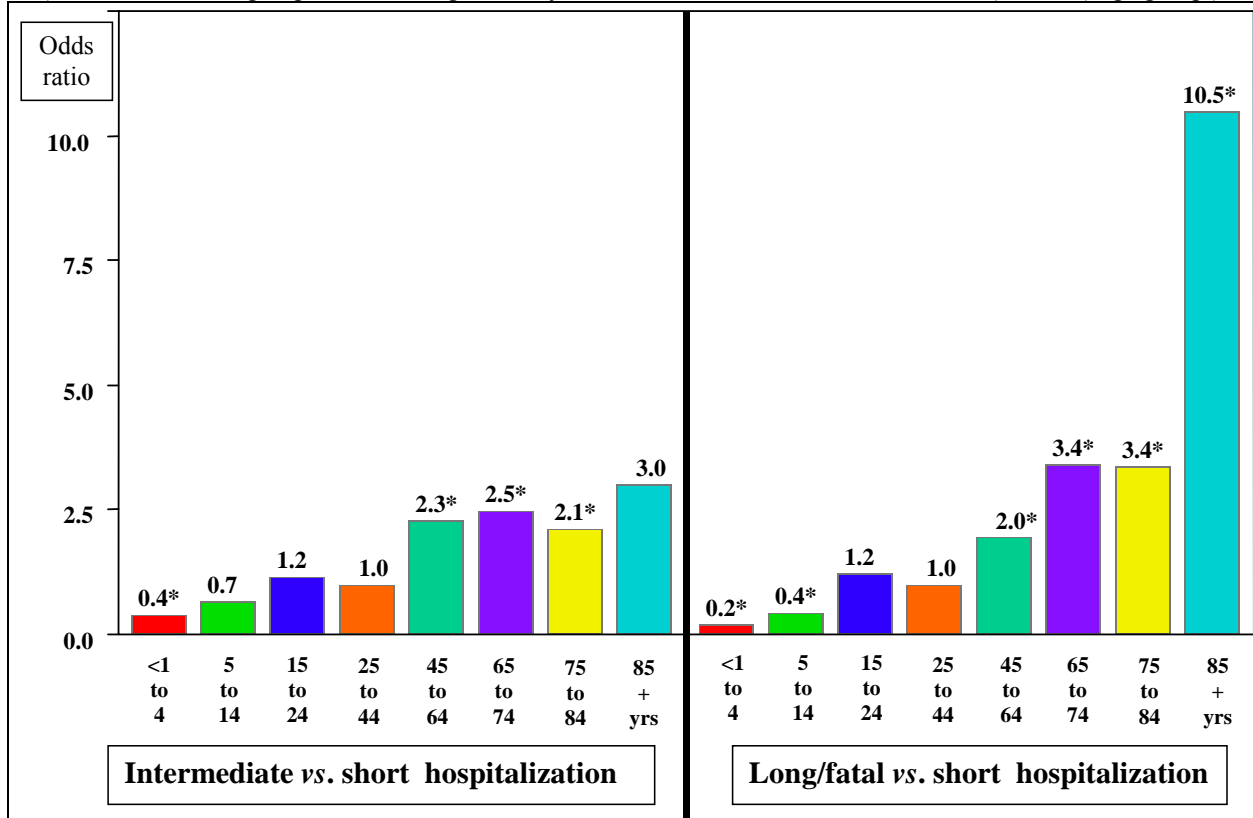
Age group differences in length of stay were analyzed more formally in a multi-variate model that also adjusted for patient gender and county of hospitalization. This model predicted the “odds” of having a short hospitalization (2 days or fewer) versus an intermediate stay (3 to 7 days), and also predicted the odds of a short hospitalization versus a long stay (more than one week) or fatal outcome. Results are summarized in Figure 18. Patient age was grouped into the eight categories listed above, where the 25 to 44-year age group was the reference. Compared to this age group, patients aged 4 years or younger had significantly lower (60%, since the odds ratio is 0.4) odds of having an intermediate stay versus a short stay (see left side of Figure 18). Conversely, odds were 2 to 3 times higher of an intermediate stay in the age groups 45 years and older.

More pronounced differences were seen in the contrast of a short stay versus a long stay or fatal outcome (see right side of Figure 18). Patients aged 14 years or younger had 60-80% reduced odds of a long/fatal hospitalization compared to 25 to 44-year-olds, while senior-aged patients were at least 3 times more likely to have a long/fatal stay. Those aged 85 years or older were more than 10 times as likely as 25 to 44-year-olds to have a long/fatal stay and nearly 50 times more likely than the youngest patients (ages 4 and younger).

There were no significant differences in these multi-variate models between gender and the length of hospitalization, but there were differences between the counties. The odds of intermediate or long/fatal stays were significantly lower among those patients hospitalized in Hawai‘i and Kaua‘i counties, compared to those hospitalized in Honolulu County (the reference). Odds of a long/fatal stay for Hawai‘i County patients was 80% lower, and 90% lower for those in Kaua‘i County. There were no differences between Honolulu County and Maui County for either comparison. These county differences did not appear to be due to a transfer of the more severe cases (those most likely to have a long/fatal stay) from Neighbor Islands to Honolulu hospitals, since the results were the same if possible transfer cases were excluded from the analysis. (Transfer status was inferred if the county of residence of the patient did not match the county of hospitalization. There is no data field which indicates the county of the actual crash.)

Figure 18. Multi-variate prediction of length of stay for pedestrians hospitalized in Hawai'i, by age group, 1996-2001.

(Asterisks indicate groups that have significantly different odds ratios than the reference (25 to 44) age group.)

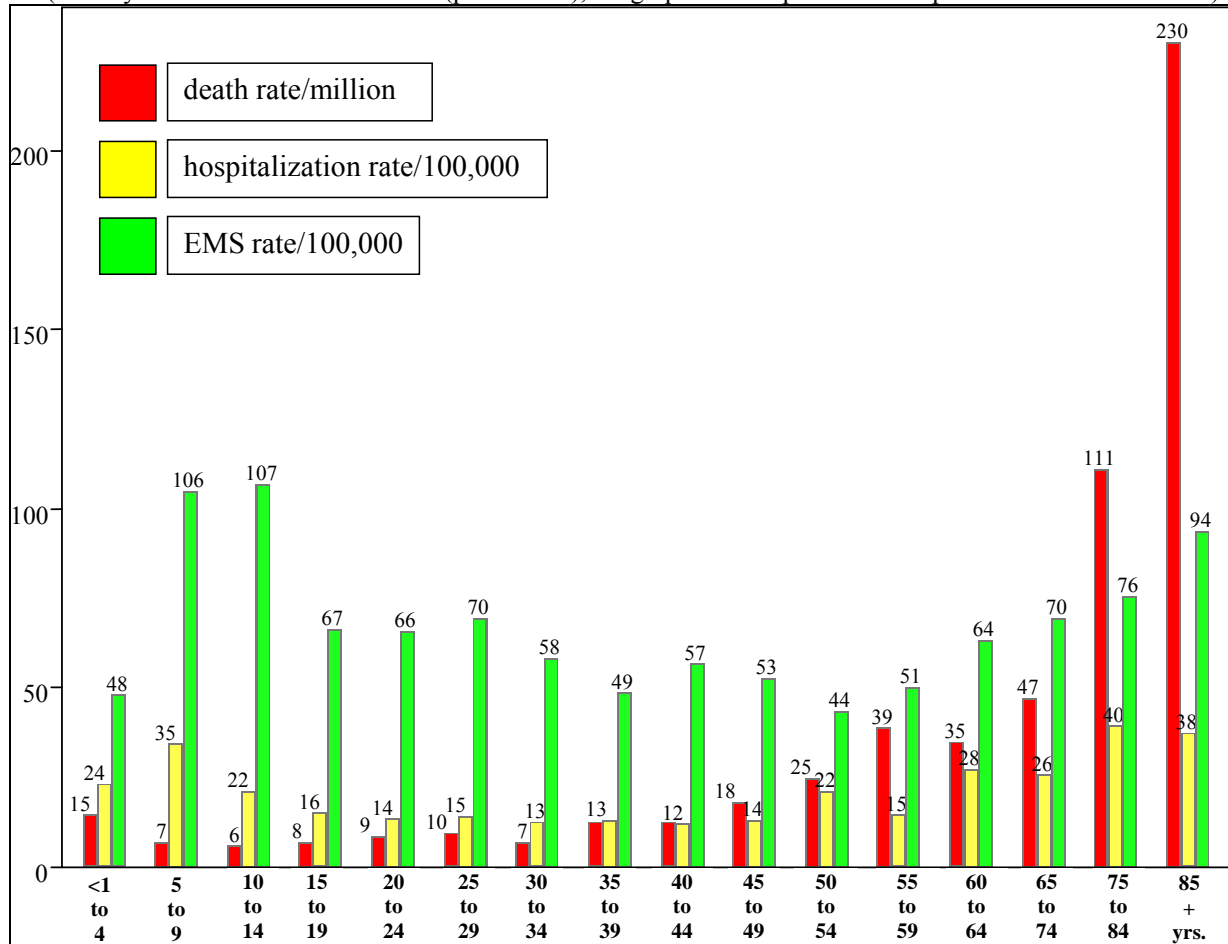


There were a total of 2,452 ambulance-attended pedestrian injuries from 1995 to 1998 on O'ahu, or about 610 per year. Comparable data from the Neighbor Islands is not available, but there are an estimated 150 injuries from the Neighbor Islands each year, or over 750 a year statewide. There was a consistently decreasing trend in the annual total on O'ahu from 694 in 1995 to 528 in 1998. However, it is not clear if this reflects a true decrease in the number of injuries among pedestrians or in ambulance usage.

The ages of the patients were widely distributed, although there were two peak ages: 22% of the victims were children aged 5 to 14 years, and 15% were 65 years or older. The highest rates were computed for the 5 to 14-year-olds, and those 85 years or older (see Figure 19). The high rates in childhood victims show a different pattern from that seen in fatally injured pedestrians, only 4% of whom were 5 to 14 years of age. This again suggests that age is a key determinant of survival among injured pedestrians. Slightly more than half (57%) were males, but that distribution varied by age, similar to pedestrians who were hospitalized: two-thirds (67%) of the child victims (ages 0-19) were males, but females outnumbered males (55%) in victims aged 55 years and older.

Figure 19. Annual rates of death, hospitalization, and ambulance usage among pedestrians in Hawai‘i, by age group.

(Fatality rates are in a different scale (per million), for graphical comparison to hospital and ambulance rates.)



About one-third (32%) of the injuries occurred during the 4-hour period of 2:30 p.m. to 6:30 p.m. (About 28% occurred during nighttime hours (6:30 p.m. to 5:30 a.m.). A significant proportion of the injuries were graded as “serious” (30%) or worse (“critical” or “D.O.A.”) (5%) by ambulance personnel. Most (80%) were ultimately transported to a hospital; only 20% were discharged at the scene. Patients who were 65 years or older were somewhat more likely to have an injury that was graded as “serious” (33%) or worse (8%) than were younger patients (30% and 5%, respectively).

The neighborhood with the highest numbers of injuries was Kalihi-Pālama (270). Waikīkī, Downtown, Ala Moana and Wai‘anae also had high numbers (between 193 and 164). Rates were computed, and the highest risk neighborhoods were the same neighborhoods, except McCully/Mo‘ili‘ili replaced Wai‘anae.

Figure 20 graphically summarizes the distribution of patient age and severity of injury by the eight neighborhoods with the highest pedestrian injury totals. The highest average ages were computed for patients struck in McCully/Mo‘ili‘ili, Downtown, Ala Moana, and Waikīkī. Patient age was 10-15 years younger on average for those struck in Wai‘anae, Waipahu and

Kailua. Nearly one-quarter (23%) of patients hit in McCully/Mo‘ili‘ili were 65 years or older, compared to only 6% of those hit in Wai‘anae. Despite being generally younger, patients hit in Wai‘anae were less likely to have “minor” injuries (50%), compared to patients struck in areas such as Ala Moana, Kailua, and Waikīkī. Injuries in McCully/Mo‘ili‘ili, and Waipahu were also less likely to have been “minor”.

Figure 20. Patient age and severity of ambulance-attended pedestrian injury on O‘ahu, by neighborhood, 1995-1998.

(Green squares indicate patients with “minor” injuries, red “x” indicates patients with “serious” injuries.)

